south saskatchewan river basin water management plan
phase two: background studies

finding the balance between water consumption
and environmental protection in the SSRB

june 2003

Alberta
Environment

contents

2 • Phase One – Water Allocation Transfers

2 • Phase Two – Finding the Balance Between Water Consumption and Environmental Protection in the SSRB

3 • Overview of Background Studies

4 • Planning for Solutions

Report Summaries

6 • Apportionment
8 • Water Allocations
9 • Irrigation in the 21st Century (AIPA)
11 • South Saskatchewan River Basin: Non-irrigation Water Use Forecasts
14 • Instream Flow Needs Determination for the South Saskatchewan River Basin
16 • Strategic Overview of Riparian and Aquatic Condition (SORAC)
19 • Recreation Flows
21 • Scenario Modeling Results (Part One)

23 • Glossary

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introduction

In Alberta, our quality of life, and life itself, depends on having a healthy and sustainable water supply for our economic well-being, communities, and our environment.

Population growth, agricultural and industrial developments are increasing demand and pressure on Alberta's water supplies, our economy and our aquatic ecosystems.

Alberta Environment is leading the development of the province's first water management plan to maximize the benefits of water use in the South Saskatchewan River Basin (SSRB) in a sustainable and environmentally responsible way. This plan will address some of the water issues and vulnerabilities in southern Alberta including the potential limitation of economic development and the potential risk to aquatic ecosystems.

Led by a government steering committee, the SSRB water management planning process involves consultation with four Basin Advisory Committees (BACs) and the general public.

The membership of the BACs, located in the Red Deer River, Bow River, Oldman River and the South Saskatchewan River sub-basins, is designed to represent and promote understanding between all sectors interested in water management within each sub-basin.

While respecting all existing water allocation licences in good standing, the multi-phased SSRB plan will address surface water management issues, including the availability of water for future allocations and river flows for the aquatic environment.

The SSRB water management plan is an example of a watershed planning approach that is recommended in the draft provincial water strategy, *Water for Life: Alberta's Strategy for Sustainability*.

The South Saskatchewan River Basin includes the sub-basins of the Red Deer River, Bow River, and Oldman River (including the South Saskatchewan River).

The planning process is a combined effort of Alberta Environment; Alberta Agriculture, Food and Rural Development and Alberta Sustainable Resource Development. Fisheries and Oceans Canada is also providing input.

Read Alberta's Water for Life Strategy – www.waterforlife.gov.ab.ca

phase one – water allocation transfers

Phase One of the water management plan was developed in consultation with the four BACs and the general public through open houses.

The Phase One Approved Water Management Plan is available online at www.gov.ab.ca/env/water/regions/ssrb

Approved and implemented in June 2002, Phase One found that water resources in the SSRB are approaching their limits. Phase One authorizes water allocation transfers and water conservation holdbacks within the South Saskatchewan River Basin, subject to Alberta Environment approval and conditions. It also resulted in the closure of the St. Mary, Belly and Waterton Rivers to applications for new water allocations pending the recommendations of Phase Two.

phase two – finding the balance between water consumption and environmental protection in the ssrb

The key goal of the second phase, scheduled for completion in mid-2004, is to find the balance between water consumption and environmental protection in the SSRB. This will involve consideration of southern Alberta's surface water needs for social and economic development and the needs of the aquatic environment.

Water conservation objective – as outlined from Alberta's Water Act*: it is the amount and quality of water necessary for the protection of a natural water body or its aquatic environment. It may also include water necessary to maintain a rate of flow or water level requirements.*

A key element of the strategy will be recommended water conservation objectives (i.e. the flow to remain in rivers) after consideration of economic and social values, and ecological requirements.

In order to develop this strategy, eight reports were completed to identify the:

- status of water allocations
- current status of the aquatic environment, and river flows required for protecting the aquatic environment
- estimates of future human demands for water
- sub-basin flow contributions to the *Master Agreement on Apportionment*

Master Agreement on Apportionment *(often simply referred to as "apportionment") outlines the division of waters between Alberta and Saskatchewan of eastward flowing interprovincial streams, including the South Saskatchewan and Red Deer Rivers. In general terms, this agreement requires that Alberta pass 50 per cent of the natural flow of the SSRB to Saskatchewan.*

The reports will be used by the BACs as resource material while developing a strategy that balances water consumption and environmental protection in the SSRB. Once Phase Two of the SSRB water management plan is in place, it will be possible to determine if and where there is water available for new allocations.

overview of background studies

The key findings of the reports are grouped into two main categories – human water use (consumptive use) and the aquatic environment's needs (non-consumptive).

A report on scenario modeling results helps to explain and illustrate the connections between the findings. Summaries of the reports follow this section.

Human Water Use (consumptive)

Below are the key findings of the *Water Allocations, Apportionment, Non-irrigation Water Use, and Alberta Irrigation Projects Association (AIPA) Irrigation* reports.

- SSRB rivers are highly allocated, with the exception of the Red Deer River.
- The Red Deer River is currently not subsidizing water use in the southern basins, but more water consumption (through existing and future licences) in the Bow and Oldman River basins will require the Red Deer River to contribute more to meet apportionment agreements.
- Any new licences issued in the Bow and Oldman Basins would have significant risk of not getting water in drier years.
- More efficient use of existing licences (ie: using more of their allocated water and reducing return flows) and issuance of new allocations will increase risks to existing junior licences and further reduce instream flows.
- As population and economic development in southern Alberta continues to grow, there will be large increases in municipal, industrial and stock-watering demands.
- Some expansion of irrigated acres in Irrigation Districts is possible within existing allocations. This expansion will increase water withdrawals and may decrease return flows through improved water management.

An instream need is a scientifically determined amount of water, flow rate or water level. Instream needs/instream flow needs are the quantities of water and water quality conditions needed to sustain riverine processes and associated ecosystems over the long term.

Aquatic Environment (non-consumptive)

Below are the key findings of the *Aquatic Environment Instream Flow Needs (IFNs), Strategic Overview of Riparian* and *Aquatic Condition* and the *Recreation Flows reports*.

- Meeting instream flow needs in the Bow and Oldman rivers downstream of the major water withdrawals requires more flow than is presently available. With existing allocations, restoring flows to these reaches would be very difficult.
- The health of the aquatic environment is believed to be following a long-term declining trend downstream of the major water withdrawals on the Bow and Oldman rivers.
- Experts rate the majority (22) of 33 mainstem river reaches in the SSRB as 'Moderately Impacted', five reaches as 'Heavily Impacted', and three as 'Degraded'.
- Minimal and preferred flows for paddle sports were determined. These flows are typically available during at least half of the usual paddling season, except in the southern tributaries of the Oldman River, where they are available for two to eight weeks of 20.

planning for solutions

The SSRB faces a dilemma. The Bow and Oldman Rivers are highly allocated and the aquatic environment is adversely affected to varying degrees. This is combined with an increasing demand for water, the commitment to respect existing licences and international and interprovincial water-sharing agreements.

The bottom-line is:

existing licences
+
protecting the aquatic environment
+
future growth

= more water than is available

Government of Alberta staff will meet with four BACs to invite feedback on how to best balance water consumption with environmental protection in the SSRB. The BACs' recommendations will be considered during the preparation of the draft plan. Some questions to explore include:

1. What level of protection of the aquatic environment is appropriate, in light of human needs? What are the practical opportunities to restore the aquatic environment in the SSRB?
2. How should the water conservation objectives tool in the *Water Act* be used?
3. What should be done to restore or sustain the river valley forests?
4. Should Alberta Environment issue allocation licences if there is a significant risk of water becoming unavailable to the licence holder?
5. Should the existing closure of the southern tributaries of the Oldman River to new allocations be continued? Should closures occur in other basins?
6. Is there sufficient water in the SSRB for all or some of the irrigation projects named in the SSRB Water Allocation Regulation?
7. Should some provision be made to guarantee that a certain amount of water remain available for development in the Red Deer River basin?

Recommendations sent to the Government of Alberta will be carefully considered during the development of the draft plan that finds the balance between water consumption and environmental protection in the SSRB. The draft plan will be available for public review in early 2004.

Once Phase Two is complete, it will be melded with the Phase One Approved Water Management Plan to become the Approved Water Management Plan for the SSRB.

report summaries

The following summaries provide information on the current and projected status of water use in the SSRB. Copies of the full reports can be found online at www.gov.ab.ca/env/water/regions/ssrb or by calling Alberta Environment at (403) 297-6250 (toll-free in Alberta by calling 310-0000).

The South Saskatchewan River, immediately downstream of the Alberta-Saskatchewan boundary, receives water from four major sub-basin areas: the Red Deer, Bow, Oldman, and the Lower South Saskatchewan River. The headwaters of the Red Deer and Bow Rivers are located entirely in Alberta, while the Oldman River receives flow from the Waterton, Belly, and St. Mary Rivers, which have their headwaters in Montana.

The international and interprovincial sharing of waters of the South Saskatchewan River is governed by two agreements:

- The 1909 ***Boundary Waters Treaty*** between Great Britain and the United States of America, which outlines the division of international streams, including the waters of the St. Mary River. This treaty permits part of the flow of the St. Mary River to be diverted in Montana to the Milk River for use in eastern Montana.
- The 1969 ***Master Agreement On Apportionment*** (often simply referred to as "apportionment") outlines the division of waters between Alberta and Saskatchewan of eastward flowing interprovincial streams, including the South Saskatchewan and Red Deer Rivers. In general terms, this agreement requires that Alberta pass 50 per cent of the natural flow of the SSRB to Saskatchewan.

The Red Deer River Basin Advisory Committee has expressed concern that the Red Deer River is subsidizing water use in the Bow and Oldman River basins to meet apportionment, thereby limiting potential development in the Red Deer River Basin.

In order to evaluate this concern in the context of the overall SSRB, Alberta Environment completed a report in April 2003; *South Saskatchewan River Sub-Basin Contributions to International and Inter-provincial Water-Sharing Agreements*. This report examined the recorded and naturalized river flows. Alberta Environment evaluated the contribution of each of the sub-basins to the water-sharing agreements and identified potential trends in their contributions.

Implications for the Planning Process

Alberta's commitment to meeting its water sharing agreements is a major factor that must be taken into consideration when setting Water Conservation Objectives and determining available water supply for use.

While the Red Deer River has not been required to significantly contribute to apportionment to date, this could change. Consideration should be given to the development of an equitable arrangement for sub-basin contributions to apportionment, especially between the Red Deer River basin and the southern basins.

Also, there could be a reduction of flows into the Oldman River should the United States use all of their entitled water from the St. Mary River.

Key Findings

Examining the most recent data available, the reports covered a time period from 1975-2001. Their key findings were:

1. The South Saskatchewan River mean annual natural flow is comprised of approximately 43 per cent from the Bow basin, 38 per cent from the Oldman basin, 18 per cent from the Red Deer basin, and about 0.7 per cent from the Lower South Saskatchewan basin.
2. Alberta, on average, passes 75 per cent of the apportionable flow to Saskatchewan rather than the required 50 per cent under the *Master Agreement on Apportionment*. As such, the large percentage of the natural flow of the Red Deer River delivered to Saskatchewan appears to be due to the non-consumption and lack of major storage devices in the Red Deer River basin rather than due to policy requirements.
3. Development within the Red Deer basin was not constrained because flows of the Red Deer River are not presently used to meet apportionment.
4. The Red Deer River was only once required to contribute slightly more than 50 per cent of its natural flow to apportionment and this was before the commissioning of the Oldman River Dam.
5. The Bow and Oldman Rivers have been providing virtually all the flows required for apportionment to date. However, the situation may change in the future if irrigation districts use their allocations more completely due to expansion and/or efficiency improvements. This will result in increased diversions and/or reduced return flows.
6. During dry years, the U.S. diversions of the St. Mary River under the 1909 *Boundary Treaty* are approximately 10 to 12 per cent of the natural flow of the Oldman River basin. The U.S. diversions will increase if the U.S. implements improvements to their storage and/or diversion infrastructure. As a result, flows in the St. Mary, Oldman and South Saskatchewan Rivers could be reduced.

water allocations report

Water allocation licences have been issued in the South Saskatchewan River Basin (SSRB) since 1894. There are approximately 20,000 licences and registrations in the SSRB.

The *Water Act* anticipates that the risk for users could be too great in some situations and permits Alberta Environment to stop receiving applications (*Section 53*) until the situation can be evaluated. This minimizes the risks to water users and the aquatic environment. For example, no water allocation licence applications are accepted on the Belly, Waterton and St. Mary Rivers. Irrigation applications are not accepted on the Highwood River, Ross Creek and Willow Creek.

Implications for the Planning Process

The allocation information was included in the scenarios already modeled. The remainder of the information will be used in the later stages of planning when considering whether to replace or amend the 1991 SSRB Water Allocation Regulation regarding irrigation. The allocation information may also focus management choices regarding Water Conservation Objectives.

The 1991 SSRB Water Allocation Regulation identified all irrigation projects. Once the acreage for each project was identified, Alberta Environment assessed a volume to correspond with the acreage based on characteristics of the project such as evaporation and seepage. This capped any further allocations for irrigation, but did not give the projects any assurance of availability of water.

Key Findings

1. Irrigation licences account for 75 per cent of the total volume of SSRB allocations.
2. Municipal licences account for 13 per cent of the total volume of SSRB allocations.
3. The large irrigation districts are nearing the limits identified in the 1991 SSRB Water Allocation Regulation.
4. The Southern Tributaries of the Oldman River have a high degree of allocation.
5. The Bow and Oldman Rivers have a significant degree of allocation.
6. The Red Deer River has a low degree of allocation.
7. Some irrigation projects in the SSRB regulation have not made an application for significant or any amounts of their limits. These projects, if they proceed, will be exposed to significant risk of water not being available in dry years.
8. Restoration of even a portion of river flows will require a concerted effort over a lengthy time period.

irrigation in the 21st century (AIPA) report

In 1996, a study of irrigation district water requirements and expansion opportunities was initiated using the best available science, technology, long-range planning, and local knowledge. This study was a cooperative effort of the Alberta Irrigation Projects Association (AIPA), representing the 13 irrigation districts in Alberta; Alberta Agriculture, Food and Rural Development; and the Prairie Farm Rehabilitation Administration. Alberta Environment acted as a resource and liaison for this study.

The study involved more than four years of field research, data collection and analysis, and focused on five component areas:

- on-farm water use
- distribution system characteristics
- irrigation district computer model development
- impacts of irrigation water shortages
- analyses of current and future irrigation scenarios

The study provides the most comprehensive and integrated assessment of past, present and future irrigation water management in Alberta's history. It was conducted in anticipation of the review of the 1991 South Saskatchewan Basin Water Allocation Regulation.

In 1991, the Alberta government established irrigation expansion guidelines that limit the amount of water that can be allocated to irrigation districts and to private irrigation projects in the South Saskatchewan River Basin (SSRB). These guidelines are incorporated in the 1991 *South Saskatchewan Basin Water Allocation Regulation* under the *Water Act*. In establishing the Regulation, the government recognized that existing scientific information on water use was inadequate to make definitive decisions on irrigation expansion and called for the Regulation to be reviewed and refined in the next decade.

Implications for the Planning Process

Evaluation of irrigated area expansion in the irrigation districts indicates the potential for expansion within existing licence allocations. However, much of this expansion will be accomplished through better and higher utilization of licensed and available stream flows potentially returning less water into downstream river reaches than in the past.

Private irrigation represents approximately 18 per cent of all irrigated agriculture in Alberta. Assessments of irrigation demands within private irrigation blocks have benefited from much of the technical information and model development that accrued through the irrigation water requirements study.

Continued evaluation of future irrigation and water management opportunities is needed to support Alberta's economic, social and environmental objectives.

Key Findings

1. Simulation modeling indicates that overall irrigation water use efficiencies could improve from the current 54 per cent to 64 per cent for the Oldman River Basin districts, and from the current 40 per cent to 55 per cent for the Bow River Basin districts. This results from continued improvement in on-farm systems, district infrastructure, and water management.
2. District losses and return flows have decreased due to rehabilitation of district infrastructure, replacement of canal laterals with pipelines, automation of structures, extensive monitoring, and improved district water management.
3. As a result of improvements in water use efficiency, reduced return flows, and higher crop water applications, a 10 to 20 per cent expansion in the irrigated area beyond the 1991 Regulation is sustainable in the Bow Basin.
4. As a result of improvements in water use efficiency, reduced return flows, and higher crop water applications, up to 10 per cent expansion in the irrigated area beyond the 1991 Regulation could be considered in the Oldman Basin.
5. Irrigation water supply deficits less than 100 mm per year are considered to be manageable without serious financial consequences for most producers.
6. Irrigation intensification and expansion will make a positive contribution to Alberta's agri-food industry and the province's social and economic objectives. Irrigation contributes to the province's agriculture resource base by increasing the economic productivity of the land by three to ten-fold compared with adjacent dryland areas.
7. Modeling results using historical weather data may not adequately represent long-term water supply and demand since future weather and stream flow may be different than in the past. Water management decisions and the operation of the infrastructure should be flexible enough to allow for mitigation of potential negative impacts of climate change, but also to take advantage of any positive impacts of shifts in weather patterns.

south saskatchewan river basin: non-irrigation water use forecasts report

This report presents long-term forecasts for population and water demand (withdrawals and consumptive use) to assist with water management planning in the basin. Independent consultant Hydroconsult ENS Services Ltd. compiled the report.

The major water use categories quantified are:

- municipal
- industrial
- stockwatering
- other agricultural (non-irrigation)
- water management (including licenced projects involving lake stabilization, remediation and flood control)

This study makes no distinction between ground and surface water supply sources and no limitations are assumed or placed on supplies to meet demands.

Implications for the Planning Process

The demand for water in the SSRB is expected to increase quite dramatically. This increasing demand for water, in light of a limited supply, represents a great challenge to southern Alberta. The water management plan should provide direction as to how to meet this challenge.

Computer modeling scenarios involving growth in water demand can be found online at www.gov.ab.ca/env/water/regions/ssrb or by calling Alberta Environment at (403) 297-6250.

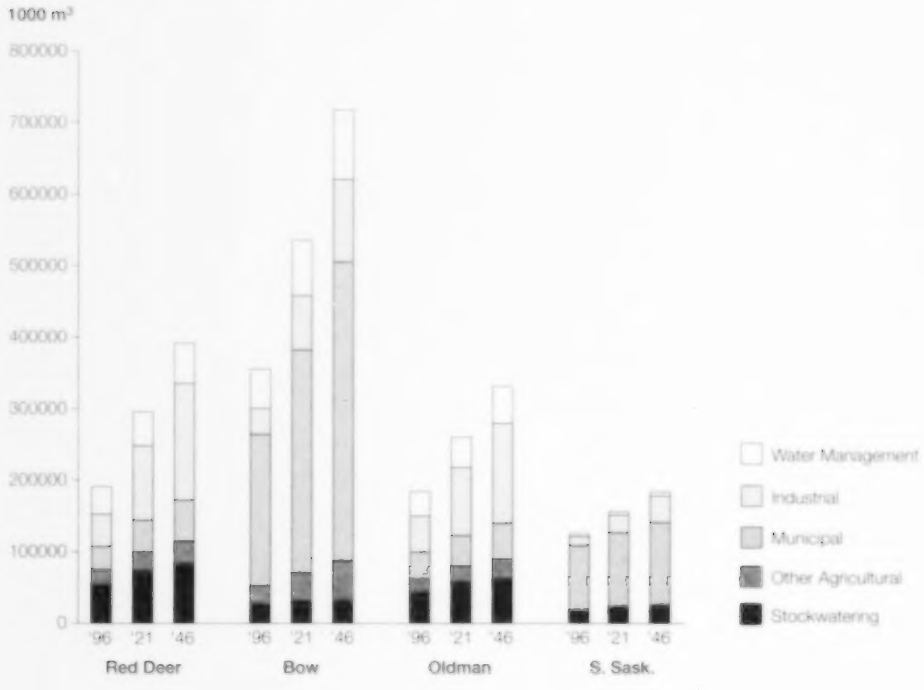
Key Findings (all findings are compared to 1996 data)

Note: this report does not include irrigation water demand.

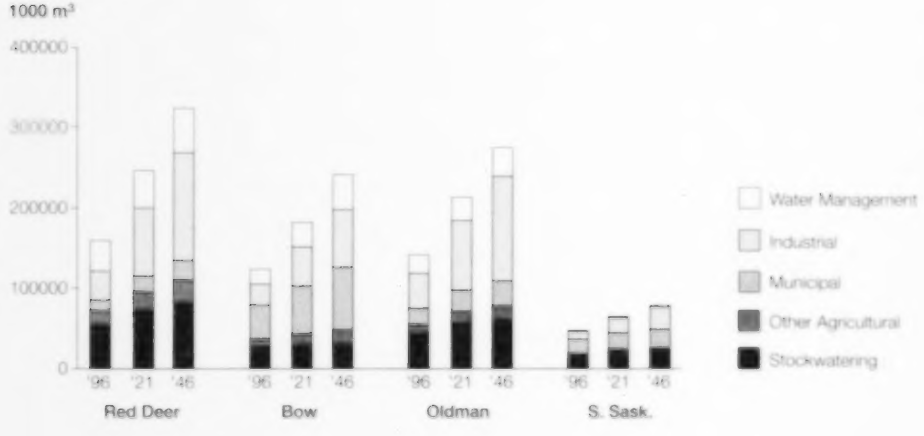
1. The population of the SSRB is expected to grow 163 per cent to 2,120,000 in 2021. By 2046, the population of the SSRB is expected to grow 245 per cent to 3,180,000.
2. Demand for non-irrigation water withdrawals in 2021 is forecasted to increase between 29 to 66 per cent. Non-irrigation consumptive use (including losses) in 2021 is forecasted to increase between 35-67 per cent.
3. By the year 2046, demand for non-irrigation water withdrawals is forecasted to increase between 52 to 136 per cent and consumptive use is forecasted to increase between 63 to 132 per cent.
4. The Bow River basin has the largest non-irrigation withdrawals in the SSRB throughout the forecast period, accounting for 44 per cent of the SSRB total in 2046. However, the Red Deer River basin accounts for the largest share of non-irrigation consumptive use throughout the period, with 35 per cent of the SSRB total in 2046.
5. The greatest volumetric increase in water withdrawals is expected to take place in the Bow River basin, where the medium case volume for 2046 is 202 per cent above 1996 levels.

6. The greatest rise in consumptive use is forecasted in the Red Deer River in 2046; where the medium case volume shows a 103 per cent increase (164,520 dam^3) over 1996.
7. In terms of water withdrawals, the municipal water use category continues to be predominant, although its share is expected to decline slightly (from 44 per cent in 1996 to 40 per cent in 2046), largely as a function of water conservation measures.
8. Industrial use is expected to show the greatest increase in water demand with its share growing from 17 per cent in 1996 to more than 28 per cent in 2046.
9. The proportion of withdrawals used for water management and stockwatering are expected to decline. The proportion of withdrawals for other non-irrigation agricultural use is expected to remain stable.
10. Industrial consumptive uses are expected to surpass stockwatering as the greatest non-irrigation consumptive use, increasing markedly during the forecast period (from a 25 per cent share in 1996 to 39.9 per cent in 2046).
11. Stockwatering decreases from 30.1 per cent in 1996 to 21.6 per cent in 2046 and municipal consumptive use decreases from 20.1 per cent in 1996 to 17.2 per cent in 2046. The proportions of consumptive use for water management and other agriculture are also expected to decline.
12. Per capita withdrawals and consumptive use are forecasted to decrease as a result of demand management initiatives. Withdrawals are expected to decline from 659 m^3/person/year in 1996 to 585 m^3/person/year in 2046. Consumptive use is expected to decline from 362 m^3/person/year in 1996 to 331 m^3/person/year in 2046.

Medium Case Withdrawals (Gross Volume of Water Diverted) by Basin and Use Category



Medium Case Consumptive Use (Gross Diversion Less Water Returned to River) by Basin and Use Category



instream flow needs determination for the south saskatchewan river basin report

This report describes instream flow needs (IFN) that will provide protection for the aquatic environment. Instream flow needs are designed to sustain the aquatic environment over the long-term.

Instream flow needs were developed for specific reaches in the South Saskatchewan River Basin:

- Red Deer River downstream of the Dickson Dam
- Bow River downstream of the Western Irrigation District weir
- Oldman River downstream of the Oldman River Dam
- St. Mary River downstream of the St. Mary River Dam
- Belly River downstream of the Belly River diversion weir
- Waterton River downstream of the Waterton Reservoir
- South Saskatchewan River to the Alberta-Saskatchewan border

The catalyst for this project was the *Water Management Policy for the South Saskatchewan River Basin* released by the Province of Alberta in 1990. This policy called for the determination of the maximum amount of water that can be allocated for irrigation in the Red Deer, Bow, Oldman, and South Saskatchewan River sub-basins. The guidelines for limiting irrigation expansion were to be reviewed in the year 2000, with improved information on instream flow needs available.

To address this need, a Technical Team was formed comprised of staff from Alberta Environment and Alberta Sustainable Resource Development. The Technical Team accessed expertise from both within and outside the Government of Alberta to complete the tasks involved in determining the IFN.

Implications for the Planning Process

The Instream Flow Needs report describes the method used to determine instream flows to sustain functioning aquatic ecosystems. The instream flow needs determinations were then included in modeling of initial water management scenarios.

In the Bow, Oldman, St. Mary, Belly and Waterton Rivers the IFN are generally much greater than existing flows under the present allocation situation. In these rivers the aquatic environment is believed to be in a state of long-term declining health. This will be a consideration in setting the direction for water management in the SSRB.

The *Instream Flow Needs Determination for the South Saskatchewan River Basin* report is one part of the technical information that will be considered during the development of the water management plan for the South Saskatchewan River Basin.

Approach

The approach to determine the instream flow needs uses the latest scientific understanding of conserving river ecosystems. The instream flow needs determinations are founded on the "natural flow paradigm". The natural flow paradigm is based on the premise that a riverine system is adapted to, and dependent on, the natural range of flow variability to sustain the ecological processes and diversity within the system.

The Technical Team used four riverine components to represent the aquatic ecosystem: water quality, fish habitat, riparian vegetation, and channel structure. Based on these four components, IFN values were generated for each of the 27 reaches on a weekly time-step.

Water Quality IFN

The water quality IFN is based primarily on flows to protect against high instream temperatures and high ammonia levels. It also ensures that minimum dissolved oxygen concentrations are maintained for the protection of fish species. Water quality IFN determinations are provided as single threshold values by season.

Fish Habitat IFN

The fish habitat IFN is based on flows to protect fish habitat. The fish habitat IFN determination is a variable flow during the open water season.

Riparian IFN

The riparian IFN determination is a variable flow to provide adequate re-seeding and growth opportunities to sustain riparian poplar forests.

Channel Structure IFN

The channel structure IFN is based on flows required to maintain channel characteristics. High flows create riffle and pool sequences, flush sediments, and sustain the dynamic nature of the channel.

Instream Flow Needs Determination

The IFN for each reach is determined by comparing the IFN value for each of the components on a week-by-week basis for the period of record. In those instances where there is overlap amongst the components, the one with the highest flow requirement was selected as the IFN.

strategic overview of riparian and aquatic condition (sorac) report

This report outlines the ecological status of the river reaches within the South Saskatchewan River Basin.

Using expert panels, two types of methods were used to obtain information: sub-basin technical workshops and a best judgment panel workshop.

Led by independent consultant Golder Associates, workshop attendees included experts from Alberta Environment; the Cows and Fish Program; Alberta Sustainable Resource Development; Alberta Agriculture, Food and Rural Development; Golder Associates and the University of Lethbridge.

The final assessment ratings are relative within the individual sub-basin, with a limited degree of cross-calibration between sub-basins. Four assessment categories for each river reach were developed:

- **Unchanged/recovered** – most factors have either remained relatively unchanged over time or recovered from any disturbance
- **Moderately impacted** – most factors have changed measurably over time and some are near or approaching ecologically unacceptable values
- **Heavily impacted** – many factors have degraded over time and are below or forecasted to be below ecologically acceptable values
- **Degraded** – most factors are now below ecologically acceptable values

Implications for the Planning Process

Considered a first step towards a more quantitative analysis, this report will be particularly useful as background information leading towards recommendations for both water conservation objectives and river reaches that could benefit from a riparian health assessment and restoration of riparian conditions.

Where some river reaches are considered degraded or heavily impacted, this report will also influence recommendations on allocations and the prospects of restoring flow to some reaches.

Key Findings: River Reach Summary

In total, for the 33 identified river reaches, the ratings are as follows:

- 1 unchanged/recovered
- 1 unchanged/recovered to moderate impact
- 22 moderate impact
- 1 moderate impact to heavy impact
- 5 heavy impact
- 3 degraded

Red Deer River Sub-Basin

The reaches of the Red Deer River are generally in better condition than those of the Bow or the Oldman Rivers. This is due to the relatively natural flow compared to the other sub-basins and the relatively low quantity of chemical and organic contaminants input to the system.

For the Red Deer River, the reach above Gleniffer Lake (Sundre gauging station to Dickson Dam) is the least impacted reach based on its lack of development, the relatively natural state of the mostly forested watershed, and the natural flow regime.

The middle reaches, with inflows from the City of Red Deer wastewater treatment plant and the Medicine and Blindman Rivers, were rated as heavily impacted and are in the worst ecological condition among the reaches of the Red Deer River sub-basin. All other reaches were rated as moderately impacted.

Bow River Sub-Basin and South Saskatchewan Sub-Basin

The lowest reach of the Bow River (Bassano Dam to Grand Forks) is warm in summer, nutrient rich, and shallow due to upstream extractions, so the ecological condition was considered degraded and among the worst of all river reaches in the SSRB.

All other reaches in the Bow River were considered moderately impacted with the exception of the reach from the Western Irrigation District Weir to Highwood River, which was rated moderately to heavily impacted (although water quality in this reach has improved due to upgrading of the wastewater treatment plant in Calgary).

Flows downstream of Bearspaw Dam are enhanced during winter months due to releases from upstream hydroelectric plants. With the addition of flows from the Highwood River further downstream, this enhanced flow coupled with the nutrient load from the City of Calgary, has resulted in a productive sport fishery in this region of the Bow River.

The reaches of the South Saskatchewan River were in better condition than the lower reaches of either the Bow or the Oldman rivers. This is due to the increased flow of the two rivers combined and the ability of one of the sub-basins to provide water when the other might be in a period of low discharge. Problems with winter grazing in riparian zones and the effects on native vegetation were noted for both reaches.

Oldman River Sub-Basin

The Oldman River was rated as moderately impacted or better throughout. Main concerns are related to the Oldman Dam and diversion and their impact on fish habitat connectivity, and the effects of reduced flooding on riparian diversity. Water quality was seen to be improving or had improved due to upgrading of the Lethbridge wastewater treatment plant and enhanced flows during low flow periods.

Southern Tributaries

Among the reaches of the southern tributaries of the Oldman River, the lower two reaches of the St. Mary River (St. Mary Dam to Oldman River) were considered degraded. This is largely due to low flows in combination with riparian areas being used as wintering sites for cattle and non-point run-off from agriculture activities.

The lower two reaches of the Waterton River (Waterton Reservoir to Belly River), and the lowest reach of the Belly River (Waterton River confluence to Oldman River), were all considered heavily impacted. Low flows were seen as the main problems for these reaches and for the lower two reaches of the Waterton River. Shallower water has significantly raised water temperatures resulting in a shift from cold-water fish species to cool-water fish species.

The upper reach of the Waterton River was considered unchanged/recovered, the only reach within the South Saskatchewan River Basin to achieve this ranking.

The flows required for canoeing and kayaking in rivers in the South Saskatchewan River Basin have been determined. There are three separate reports:

- Streams of the Oldman River basin along with the South Saskatchewan River, and the Milk River (although the latter is not in the SSRB).
- The Bow River and its tributaries.
- The Red Deer River.

Two levels of flow were determined: minimum flows – low flows that still provide a reasonable quality experience, and preferred flows – the low end of the optimal range.

The flows were determined by combining four different methods:

1. Data from River Trip Report Cards (an Alberta Environment program)
2. "Expert judgments" expressed in regional guidebooks and maps
3. Personal experience and judgment of the author and other highly experienced paddlers
4. Hydraulic modeling that investigated discharges needed to provide typical depths of 0.6 and 0.75 m, for minimum and preferred flows, respectively

These reports were prepared by Dr. Stewart Rood, of the University of Lethbridge, with partial funding from Alberta Environment.

Implications for the Planning Process

This information is provided as general information for those members of the public with an interest in paddle sports in southern Alberta. It will help them evaluate scenario modeling results by comparing recreation flows with the flows predicted by alternative scenarios.

Key Findings

1. In most of the river reaches of the SSRB minimal paddling flows are present during at least half of the paddling season (May 15 – September 30). In many reaches minimal paddling flows are present most of the summer. Flows for paddling are usually not sufficient for paddling in the southern tributaries of the Oldman River downstream of the dams and weirs.
2. While not part of the reports, subsequent modeling of recreation flows under existing conditions and commitments (Base Scenario) indicates the following:

Base Scenario

River	"Minimal Flows"[1]	"Preferred Flows"[2]
Red Deer below Dickson Dam	15-18	10-13
Bow		
- WID[3] weir to Bassano Dam	18-20	16-19
- Bassano Dam to mouth	12	10
Oldman		
- Oldman River Dam to LNID[4] weir	20	18
- LNID[4] weir to Belly River confluence	8-13	6-9
- Belly River to mouth	10-12	7-9
South Saskatchewan	15	11
St. Mary		
- above dam	12	8
- below dam	4	3
Belly	2-7	1-7
Waterton below dam	4	3

[1] Approximate minimum flows on average May 15 to September 30 After flows have been in the river over a 68 year period of record (1928-1995)

[2] Minimal Flows – Low flows that still provide a reasonable quality of presence

[3] Preferred Flows – The low end of the optimal range

[4] WID – Western Irrigation District

[5] LNID – Lethbridge Northern Irrigation District

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South Saskatchewan	15	11
St. Mary		
» above dam	12	8
» below dam	4	3
Belly	2-7	1-7
Waterton below dam	4	3

** Approximate number of weeks on average (May 15 to September 30) when flows have been in the river over a 68-year period of record (1928-1995)*

[1] *Minimal Flows – Low flows that still provide a reasonable quality experience*

[2] *Preferred Flows – The low end of the optimal range*

[3] *WID – Western Irrigation District*

[4] *LNID – Lethbridge Northern Irrigation District*

scenario modeling results report (part one)

Because of the complexity involved when establishing water conservation objectives, Phase Two scenario modeling was divided into two parts. Part One is an exploratory and educational component to gather information on the current and "committed to" state of the basin, plus the consequences of particular water management decisions.

This information was gathered through eight scenarios, which are simulated using Alberta Environment's Water Resources Management Model (WRMM). The scenarios were chosen with the assistance of the SSRB BACs and reflect various "conditions" in the basin (e.g. existing commitments, apportionment, instream needs vs instream objectives, consumptive uses, etc.).

The WRMM compares water supply in the rivers with water use demands.

- Water supply is what happened over a 68-year period of record. This period reflects a wide range of conditions, from severe drought to major floods.
- Demands include licences to withdraw water for irrigation, municipal and industrial use, storage, apportionment agreements, etc. Existing instream objectives* (IO's) were also taken into account.

**An instream objective (IO) describes the desired level of flow or water quality that considers both instream and withdrawal (eg: municipal, irrigation, industry) needs. Existing IOs in the SSRB offer varying degrees of benefits for the aquatic environment, as they were adopted without the present day knowledge of instream flow needs.*

Implications for the Planning Process

These are initial educational scenario results, which have helped to narrow down the viable options for the planning process. These scenarios will assist the BACs in identifying additional scenarios to be investigated leading to the recommendation of Water Conservation Objectives in Phase Two.

Key Findings

For most years, the water supply provides flows above existing instream objective values. However, water supply and management in dry years remains the governing factor. The following key findings apply primarily to those dry years:

1. ***Current Allocations and Commitments, and District Irrigation at SSRB Regulation Acreages (Base Scenario)***
   - In the Red Deer and Oldman/South Saskatchewan mainstems, there are a few consumptive use deficits, and existing instream objectives are always met.
   - In the Bow sub-basin, junior allocations and commitments have frequent, substantial deficits. Existing instream objectives are frequently not met above Bassano. They are always met below Bassano, but instream flows are frequently at the instream objective value of 11.33 m^3/s (400 ft^3/sec). Except for the Western Irrigation District (WID), the Bow River Irrigation District (BRID) and the Eastern Irrigation District (EID) can achieve their maximum areas under the SSRB Regulation with their current licences.
   - In the Oldman Southern Tributaries, junior allocations (there are no commitments) have frequent, substantial deficits. Existing instream objectives are always met.

2. ***Potential Development Scenarios***

a) Non-District Irrigation at SSRB Regulation Acreages

- In the Red Deer sub-basin, junior allocations and commitments have infrequent, small deficits as compared to the Base Scenario. The Special Areas Water Supply Project has some deficits that need further evaluation.
- In the Bow sub-basin, performance of the WID has significantly improved with an additional allocation. It should be noted that the WID has applied for an additional allocation but current IOs would limit the volume that can be diverted.
- In the Oldman/South Saskatchewan mainstem (where most of the Non-District expansion occurs), deficits to junior allocations and commitments increase since the consumptive demand relying on the Oldman Reservoir storage is increased.
- In the Oldman Southern Tributaries (where the expansion is limited to Non-District irrigation applications received), deficits to junior allocations are similar to the Base Scenario.

b) Irrigation District Expansion Beyond SSRB Regulation Limits, and 50-year Projected Non-Irrigation Allocation

This scenario illustrates expanding Irrigation Districts within existing allocations to 110 per cent (Oldman basin) and 120 per cent (Bow basin) of SSRB Regulation Acreages:

- Marginally increases deficits to all districts except WID, which has a significant deficit increase. BRID, EID and United Irrigation District experience no deficit increase.
- Has a substantial negative impact on junior licences and commitments. The 50-year projected non-irrigation water use has very frequent, large deficits.

3. ***Exploratory Scenarios***

- Managing the SSRB to meet instream flow needs (IFNs) for the aquatic environment is not possible because of existing allocations. A 20 per cent reduction in water consumption provides a modest increase in instream flows but these are still substantially below the IFN values.
- Applying IFNs to commitments and junior licences would render them unusable.
- A fixed 50 per cent of natural flow from the Red Deer sub-basin to apportionment would enable substantial development in the Red Deer basin. However, this would result in frequent large deficits to junior allocations and commitments in the Oldman/South Saskatchewan mainstems.
- In the Red Deer sub-basin, there is potential to increase the instream objective (IOs) values above existing levels and provide for additional allocation. However, the opportunity for increasing IOs and issuing additional allocations in the Bow/Oldman sub-basins are limited.

Glossary

Allocation » When water is redirected for a use other than for household purposes (use by an owner of property adjacent to a water body or from an aquifer), it is referred to as an allocation. All water users (except for household users) apply to Alberta Environment for a licence to use a set allocation of water. This water allocation outlines the volume, rate, timing and any restrictions for a diversion of water.

Aquatic ecosystem » An aquatic area where living and non-living elements of the environment interact. These include rivers, lakes and wetlands, and the variety of plants and animals associated with them.

Aquatic environment » The components of the earth related to, or living in or located in or on water or the beds or shores of a water body, including but not limited to all organic and inorganic manner, and living organisms and their habitat, including fish habitat, and their interacting natural systems.

Basin Advisory Committees » Established in the four sub-basins of the South Saskatchewan River Basin, membership on a BAC is designed to represent all sectors interested in water management in the sub-basin. Each sector selected its own representatives on the BAC. Typical sectors represented in a BAC include irrigation agriculture, non-irrigation agriculture, ecosystem protection/environmental, First Nations, industry, municipal and recreation.

Consumptive use » The balance of water taken from a source that is not entirely or directly returned to that source.

First-in-time, first-in-right » The principle used to prioritize water rights in Alberta. This principle, in existence since 1894, means that water rights are prioritized according to how senior the licence is, regardless of its use. The older the licence, the higher the user is on the priority list.

Headwaters » The source and upstream waters of a stream.

Infrastructure » Physical facilities such as canals, reservoirs, pipelines and treatment plants.

Instream flow » The rate of flow in a river, without reference to its purpose.

Instream needs (IN) » An instream need is a scientifically determined amount of water, flow rate or water level. Instream needs / instream flow needs are the quantities of water and water quality conditions needed to sustain riverine processes and associated ecosystems over the long term.

Instream Objectives (IO) » Flows that are to remain in the river via dam operations or as a restriction on licence holders. IOs are in place in all the SSRB rivers below the dams, although some offer limited protection of the aquatic environment.

Irrigation district (ID) » A water delivery system for irrigation in a given region. In Alberta, there are 13 irrigation districts. About 50 communities receive water for domestic use through irrigation districts.

Minimum flow » The term used in the SSRB Water Allocation Regulation to stipulate the least amount of flow that must remain in the St. Mary, Belly and Waterton Rivers. For purposes of modeling, they are also referred to as IOs. These flows offer very limited protection of the aquatic environment.

Natural flow » In a regulated river, natural flow describes the flow that would be in the river in the absence of man-made influences. It is a calculated value based on-stream gauge readings, diversions, and other factors.

Non-consumptive use » A use of water in which all of the water used is directly returned to the source from which it came. For example, water left in the stream for the aquatic environment and/or recreation is a non-consumptive water use.

Potable water » Water that is fit for human consumption, but has not been treated.

Return flows » Water that has been withdrawn from a river, then returned after use or un-used. Examples would be treated wastewater discharges or water that has passed through the canals of an irrigation district but not used on crops. Sometimes water can be withdrawn from one river but returned to another. Return flows may also include drainage water from surface runoff following major precipitation events and from shallow groundwater discharge.

Riparian area » The area along streams, lakes and wetlands where water and land interact. These areas support plants and animals, and protect aquatic ecosystems by filtering out sediments and nutrients originating from upland areas.

River basin » An area of land drained by a river and its associated streams or tributaries. Alberta's *Water Act* identifies seven major river basins within the province: Peace/Slave River Basin, Athabasca River Basin, North Saskatchewan River Basin, South Saskatchewan River Basin, Milk River Basin, Beaver River Basin, Hay River Basin.

South Saskatchewan River Basin » The South Saskatchewan River Basin includes the sub-basins of the Red Deer River, Bow River, and Oldman River (including the South Saskatchewan).

Sub-basin » A part of a river basin drained by a tributary or having characteristics that are significantly different from other areas in the basin.

Surface water » Most Albertans get their water from surface water sources such as lakes and rivers. The runoff from rain and snow renews our surface water sources each year. If the demand for surface water is higher than the supply, there will not be enough available to balance the needs of Albertans, the economy and the environment.

Water Act » In Alberta, the *Water Act* is used to protect the quality of water and to manage its distribution. This legislation regulates all developments and activities that might affect rivers, lakes and groundwater.

Water allocation transfer » A water allocation transfer occurs after the holder of an existing water withdrawal licence agrees to provide all or part of the amount they are allocated to another person or organization. Alberta Environment must approve any transfer of this kind. When this occurs, the allocation is separated from the original land, and a new licence, with the seniority of the transferred allocation, is issued and attached to the new location. Under the *Water Act*, Alberta Environment can place conditions on the new licence. Water allocation transfers can occur only if authorized under an approved water management plan, or by the Lieutenant Governor in Council.

Water conservation holdback » If the Director is of the opinion that withholding water is in the public interest to protect the aquatic environment or to implement a water conservation objective, and the ability to withhold water has been authorized in an applicable approved water management plan or order of the Lieutenant Governor in Council, the Director may withhold up to 10 per cent of an allocation of water under a licence that is being transferred.

Water conservation objective » As outlined in Alberta's *Water Act*, a water conservation objective is the amount and quality of water necessary for the protection of a natural water body or its aquatic environment. It may also include water necessary to maintain a rate of flow or water level requirements.

Water licence » A water licence provides the authority for diverting and using surface water or groundwater. The licence identifies the water source; the location of the diversion site; an amount of water to be diverted and used from that source; the priority of the "water right" established by the licence; and the condition under which the diversion and use must take place.

Water management plan » Alberta's *Framework for Water Management Planning* outlines the process for water management planning and the components required for water management plans in the province. It applies to all water bodies, including streams, rivers, lakes, aquifers and wetlands.

Water quantity modeling » Analysis, usually computerized, that predicts possible changes in the flow and distribution of water in rivers and other bodies of water, resulting from water withdrawals.

Watershed » An area of land that catches precipitation and drains into a larger body of water such as a marsh, stream, river or lake.

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